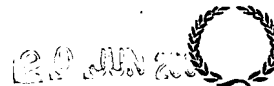




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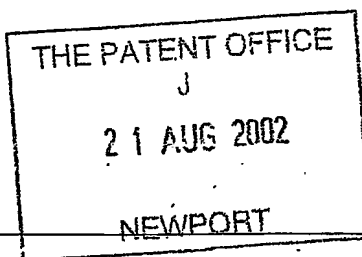
Dated

17 September 2003

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Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)



The Patent Office

Cardiff Road
Newport
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1. Your reference

2002P13270 GB / R76 / JJP / JJP

2. Patent application number
(The Patent Office will fill in this part)

0219466.0

3. Full name, address and postcode of the or of each applicant (underline all surnames)

ROKE MANOR RESEARCH LIMITED
Old Salisbury Lane, Romsey
Hampshire SO51 0ZN

Patents ADP number (if you know it)

56154 55006

If the applicant is a corporate body, give the country/state of its incorporation

UNITED KINGDOM

4. Title of the invention

Multi-carrier Power Amplifier with Switched PSU voltages

5. Name of your agent (if you have one)

Jan Payne

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

Siemens Shared Services Limited
Intellectual Property Department
The Lodge, Roke Manor
Romsey
Hampshire SO51 0ZN

Patents ADP number (if you know it)

08439358001 ✓

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each these earlier applications and (if you know it) the or each application number

Country Priority application number
(if you know it)

Date of filing
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

Yes

- a) any application named in part 3 is not an inventor, or
- b) there is an inventor who is not named as an applicant, or
- c) any named applicant is a corporate body.

See note (d))

9. Enter the number of sheets for any of the following items you are filling with this form. Do not count copies of the same document

Continuation sheets of this form

| | |
|-------------|---|
| Description | 3 |
| Claim(s) | 0 |
| Abstract | 0 |
| Drawing(s) | 0 |

10. If you are also filing any of the following, state how many against each item.

Priority documents

Translation of priority documents

Statement of inventorship and right to grant a patent (*Patents Form 7/77*)

Request for preliminary examination and search (*Patents Form 9/77*)

Request for substantive examination (*Patents Form 10/77*)

Any other documents
(please specify)

1. I/We request the grant of a patent on the basis of this application

Signature

Date

Jan Payne
Intellectual Property Attorney

19.08.2002

2. Name and daytime telephone number of Person to contact in the United Kingdom

Jan Payne

01794 83 3866

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Notes

- a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505

Multi-carrier Power Amplifier with switched PSU voltages

Background

Base stations used for 3rd generation mobile communication and base stations used for 2nd generation multi-carrier operation require linear power amplifiers. The linear power amplifiers in these applications operate with amplitude-variant Radio Frequency signals. The power amplifier is designed to be able to deliver the maximum peak envelope power and is usually fed with a constant voltage power supply that is dimensioned to deliver the peak power.

This method is inefficient because the instantaneous envelope power is well below the peak power most of the time, and therefore the amplifier unnecessarily dissipates excess power due to the large constant power supply voltage.

Prior art

Several different methods have been cited to improve the efficiency of linear power amplifiers. One method is based on the envelope elimination and restoration (EER) technique. This method has severe bandwidth limitation and therefore is not suitable for the amplification of the broadband signals used in the current mobile communication systems.

Another method is based on the principle of the Doherty amplifier. Both the EER and the Doherty amplifiers suffer from spectral spreading effects, bandwidth limitation and therefore not used in the present systems.

Description of Invention

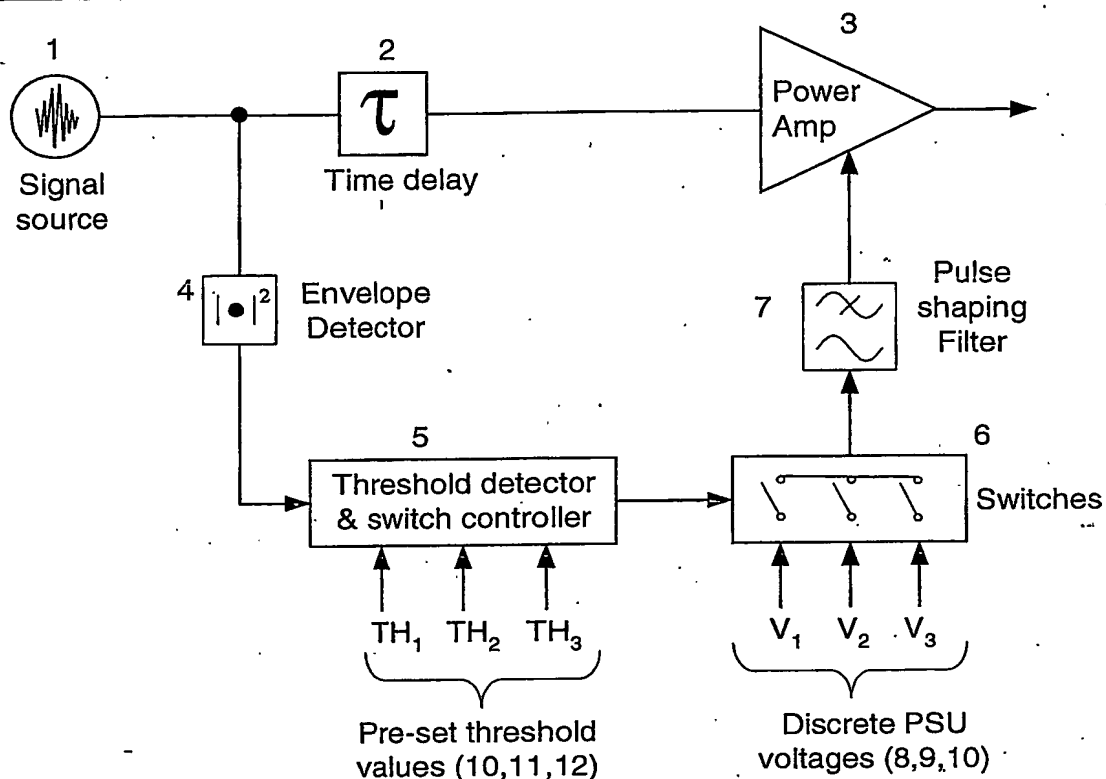


Figure 1 Switched voltage power amplifier

With reference to figure 1 the amplitude variant source signal (1) contains the information that is to be transmitted. This signal is applied to the envelope detector (4), which provides a value that is proportional to the instantaneous power of the signal. This value is applied to a threshold detector (5).

The source signal is also applied to the power amplifier (3) via the time delay (2).

The threshold detector compares pre-set threshold values with the values representing the instantaneous power and provides a control signal to turn the appropriate switch on. Figure 1 illustrates a case with 3 discrete power supply voltages. If the instantaneous envelope of the signal is below threshold 1, then V_1 voltage is applied to the power amplifier (3). Between thresholds 2 and thresholds 3 V_2 is applied to the power amplifier. Finally, for all envelope values above the pre-set threshold 3, V_3 is selected by the switches (6).

It should be noted that the invention is not restricted to 3 discrete values, and in fact any number of steps may be used. The number of discrete steps, the pre-set threshold values and the corresponding supply voltages are determined to match the properties of the transmitted signal and the characteristics of the power amplifier.

An important aspect of the invention is the pulse-shaping filter (7). This filter limits the slew rate of the power supply voltage as the DC voltage is switched between the discrete values. This in turn minimizes the undesirable spectral spreading of the

transmitted signal that may be caused by the power amplifier as the supply voltage is varied. Variants with and without such a pulse shaping filter are claimed herein.

The purpose of the time delay (2) is to match the overall delay in the path containing the envelope detector, the threshold detector, the switches and the pulse-shaping filter with the delay of the power amplifier. This ensures that the signal and the appropriate power supply voltage are applied synchronously at the correct instant.

It should be noted that blocks 2,4 and 5 may be implemented digitally in the baseband section of the transmitter or alternatively these blocks may be realized by analog circuitry. The efficiency enhancement method described here may be used in conjunction with both, feed forward and with pre-distortion linearisation techniques.